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Describing the Distribution of Training Loads in the Microcycles and Mesocycles of Competitive Basketball

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ABSTRACT

Planning the periodization of training loads in harmony with the different periods of the season is a unique role for members of the sports team staff. Therefore, the objective of this study is to describe the distribution of training loads in microcycles and mesocycles in competitive basketball through a narrative review of the literature. In a consultation in three electronic databases (Google Scholar, PubMed and Science Direct) in Portuguese, English and/or Spanish, a total of 45 primary scientific articles were chosen that addressed the distribution of training loads in basketball and team sports in set with 21 complementary secondary references on the main thematic. It was demonstrated that compulsory load is a basic entity necessary to raise performance levels in the sporting form. Monitoring and numerically controlling the external load imposed can result in favorable responses in the internal load of athletes. In this aspect, some key metrics collaborate effectively, such as: acute-chronic workload ratio, monotony index and strain index. Short-term microcycles make it possible to see the horizontal distribution of loads, built session after session. In contrast, mesocycles group several consecutive microcycles to adjust loads vertically. Invariably, a rational and logical long-term distribution can result in improvements in athletic performance and low injury incidence. However, to achieve these objectives through the systematic periodization of loads, it is necessary to face pedagogical problems that belong to a multidimensional sphere. That is, we are manipulating an extremely complex and imperfect construct, with great dependence on the interpretation made by responsible practitioners.

KEYWORDS: *Basketball, Workload, Athletic Performance, Team Sports*

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1. INTRODUCTION

Modern basketball as an intermittent team sport demands high-intensity stress with its varied patterns of explosive movements and high reactivity.[1,2,3] These tasks are performed non-linearly, in different vectors (anteroposterior, mediolateral and longitudinal), combined with the three planes of movement.[4,5]

During the complex training process, athletes are subjected to physiological and mechanical stressful loads. Physiological adaptations refer to the delivery of oxygen to active muscles and the use of energetic substrates as fuels for effort.[6] For example, the metabolisms responsible for the resynthesis of creatine phosphate (alactic anaerobic system), glycolysis (lactic anaerobic system) and oxidation of free fatty acids (aerobic system) are required for superior performance in the modality.[2,7] The proportion of each of these three metabolic pathways is equivalent to 80%, 10% and 10%, respectively.[8]

Mechanical loads, in turn, act directly on the body's locomotor system, adapting bone, muscle, tendon and cartilage tissues.[6] In this case, specific movements involving changes of direction, accelerations, decelerations, reaccelerations, passes, shooting, dribbling, jumping and landings.[1,2,3]

Since the changes to the rules of the sport adopted in 2000, specific motor actions have been requested more frequently within the same period of game duration.[9] It is observed that the total distance covered in a match is around 4500-5000 meters, with alternation of intensity in movements every 2 seconds.[5,10,11,12] One concrete piece of information is that professional players perform an average of 49.1 accelerations, 89.1 decelerations, 324.1 changes of direction and 49.8 jumps in training sessions.[13]

Technical (specific skills), tactical (game strategy), physical (biomotor capabilities) and psychological (emotional balance) aspects work together in the search for continuous improvement in the players' sporting form.[14,15,16] Linked to this, the so-called optimal sporting form of a team is directly subordinated to the combination between the training state (general organic adaptations) and the preparation state (optimal state of readiness to compete).[16]

Periodizing training comprises meticulously organizing the entire process of guiding loads in the three major periods of the season: preparatory, competitive and transition.[17,18,19] The original idea of periodization is to provide smart peaks of performance at critical moments to face opposing teams with a competitive advantage.[15,20,21] To choose the appropriate periodization model, the team's current reality (competitive category, gender, league calendar, general and specific objectives) must be taken into account.[15]

In parallel with the selected periodization model, load distribution is created throughout the long season calendar. The central role of monitoring and distributing loads is to be able to adequately dose adaptive stimuli in training sessions. The intention would be to provide favorable conditions for players to optimize athletic performance in games.[2,13,22]

A large part of training adaptations are orchestrated by the principle of load or overload.[6] This principle advocates that systematized physical sports training causes a regular break in organic homeostasis, inducing central and peripheral effects that trigger positive or negative changes. The regular goal is that in this process positive supercompensatory restoration predominates to raise physical fitness to levels higher than previous ones.[2,6]

To achieve this purpose, it is necessary to have a balance between the stress produced by the imposed load coupled with compatible recovery.[23] Therefore, two antagonistic phenomena govern this delicate situation: functional overreaching and non-functional overreaching. Functional

overreaching is something that coaches desire. After a certain load, the athlete's performance temporarily declines, and subsequently, following rest, his work capacity increases. The opposite happens in non-functional overreaching, when recovery from physical effort is not adequate enough and, as a result, symptoms of maladaptation emerge.[5]

In fact, an accurate interconnection between external (manipulated) and internal load (organic responses) can produce the desired adaptations, reducing the risk of non-functional overreaching, overtraining and injuries.[13,24,25]

The uninterrupted need for immediate results in the competitive arena can compromise the health of players and the training process due to the significant increase in psychobiological stress.[16] Faced with this dilemma, rigorously detailing load management will probably generate an improvement in readiness to train and compete, due to the sustainable assimilation of accumulated fatigue and a lower probability of non-contact injuries.[13,26,27,28]

However, some coaches still have many doubts and frequent difficulties when developing periodization and distributing loads in the microcycles and mesocycles of the season. Therefore, the objective of this research is to describe the distribution of training loads in the microcycles and mesocycles of competitive basketball through a narrative review of the literature.

2. METHODOLOGY

This manuscript is framed as a narrative review of the literature, whose methodological approach consists of a careful analysis of a particular thematic.[29,30] During the study, the main problem acquires constructive arguments, contextualized in the available theoretical-scientific framework.[29,31]

The typical structure of this type of review follows legitimized techniques through narrative with coherent vocabulary in accordance with solid academic guidelines. A useful pedagogical concept is to have prior knowledge of the nature of the phenomenon examined to be able to carry out the work with due security and mastery.[30] From this, the problem is systematically investigated to try to answer outstanding doubts, hypothesize solutions, identify gaps, provide insights, present controversial points and factors that have practical implications in the real world.[29,30,31]

The consultation in three electronic databases (Google Scholar, PubMed and Science Direct) in Portuguese, English and/or Spanish allowed the selection of texts discussing the distribution of training loads in competitive basketball. In the Boolean search for words, the following key terms were used: “training load AND/OR basketball”, “periodization AND/OR basketball”, “microcycles AND/OR basketball”, “mesocycles AND/OR basketball”, “training load AND/OR team sports”, “periodization AND/OR team sports”, “external load AND/OR basketball”, “internal load AND/OR basketball”, “periodization AND/OR team sports”, “microcycles AND/OR team sports”, “mesocycles AND/OR team sports”, “external load AND/OR team sports”, “internal load AND/OR team sports”, “training load AND/OR injuries”, “training load AND/OR performance”, “training load AND/OR acute-chronic workload ratio”, “acute load AND/OR basketball”, “chronic load AND/OR basketball”, “acute load AND/OR team sports”, “chronic load AND/OR team sports”, “training load monitoring AND/OR basketball”, “training load monitoring AND/OR team sports”, “training load AND/OR metrics”, and “periodization models AND/OR training load”.

The first step in choosing articles was carried out through three phases: a)- reading the title, b)- reading the abstract and c)- reading the entire body of the text. In addition, inclusion and exclusion criteria were adopted to more rigorously investigate studies on the topic.

The inclusion criteria were chosen: 1)- investigations that addressed training loads in basketball and team sports, 2)- manuscripts presenting the distribution of loads in the microcycles

and mesocycles of basketball and team sports, 3)- texts on planning periodization in basketball and team sports, 4)- articles about the distribution of training loads to optimize performance in basketball and team sports and 5)- studies that presented the distribution of training loads with the purpose of preventing injuries in basketball and sports collectives. The exclusion criteria met: incomplete texts, duplicate articles and manuscripts on individual sports.

The final text was made up of 52 scientific research published between the years 2005 and 2023, 08 textbooks in the field of sports training theory, 03 investigations into the methodology of scientific research, 02 presentation slides and 01 master's thesis in the field of sports science.

3. CHARACTERIZING TRAINING AND GAMES LOADS

Load, in sporting activity, is any physiological, mechanical or mental stressor component that acts on the athlete's locomotor system.[32,33] Systematic training and regular tournaments accumulate load.[34] This load can vary with a certain frequency, intensity and duration.[2]

The load entity is classified as external (training or game dose) and internal (psychobiological responses to the implemented external load). In practice, external load involves manipulating the variables of intensity, volume, frequency, density, task complexity and monitoring movement patterns through video analysis or triaxial accelerometry.[2,8,13,15,20,35,36] On the other hand, the internal load is divided into objective and subjective. The objective internal load contains the physiological, biochemical and neuromechanical metrics necessary for direct assessment. Regarding subjective internal load, psychometric questionnaires are used to collaborate in the indirect interpretation of psychoperceptive responses.[4,13,15,37,38,39]

It is possible to analyze the load in absolute and relative format. The accumulation of exposure to training and game loads without considering the application rate, history and level of physical condition refers to absolute load. However, when considering these three variables mentioned in the training prescription, we are referring to relative load.[38]

When implementing loads, if they are too low, the desired adaptations will not occur and, in the long term, detraining can manifest itself and increase the probability of non-contact injuries. In contrast, if loads are excessively high, with incompatible recovery, the injury risk increases substantially.[2,20,33,40] Strict control over the volume of loads, with reestablishment of fatigability, serves as a guide for a balance between improving performance and maintaining the health status of athletes.[41]

The internal load of training sessions can be calculated simply by multiplying the total duration of the session in minutes by rating of perceived exertion (RPE) scale. This mathematics is applied extensively in physical preparation sessions, technical-tactical training, recovery and games.[13,23,24,33,36,38,42,43] For example, the athlete performed a technical-tactical training session lasting a total of 90 minutes. Then, up to 30-minutes after the end of the session, the player is asked about their RPE on a scale of 0-10. The score of 0 representing “easy effort” and 10 “exhaustive effort”. Let's assume the reported value of RPE is 7. In this case, multiplying 90 minutes by 7 will result in 630 arbitrary units (au). This basic formula is known in publications as session-RPE.[9,10,13,20,40]

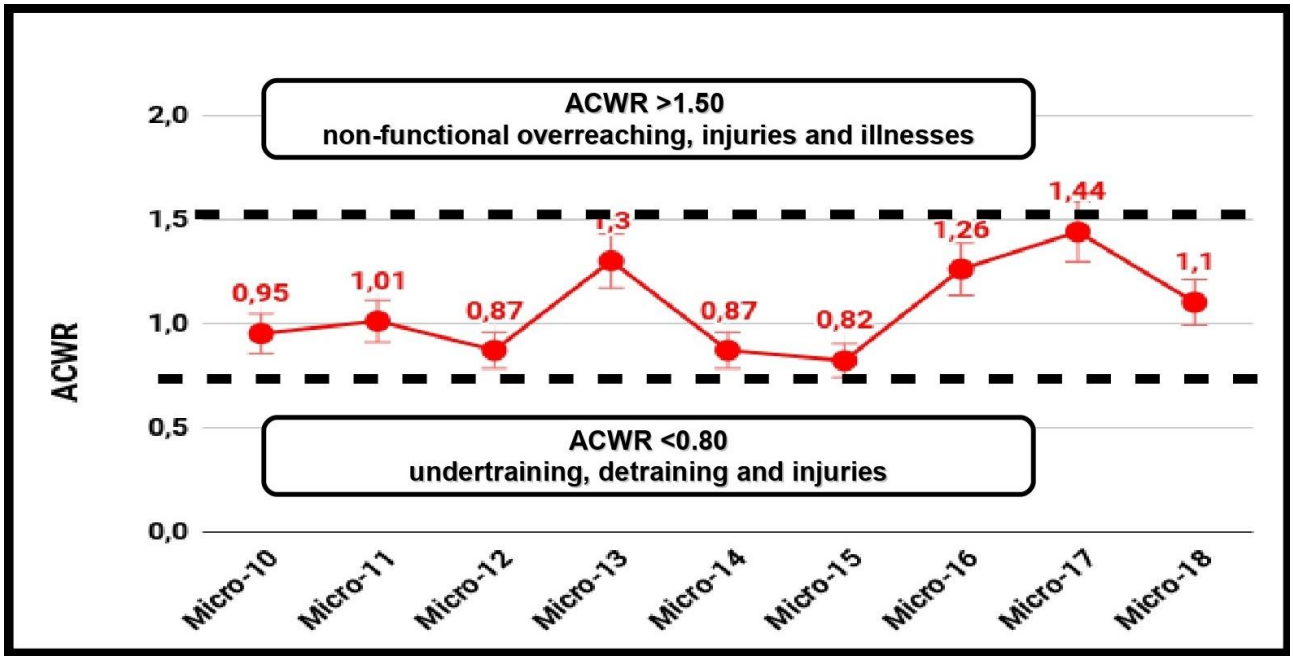
Under this same umbrella, there is our disposal as a tool the use of subjective perception of differential effort, which analytically distinguishes stress into a cardiovascular, muscular or mental component.[6,32] It is claimed that this resource is more sensitive and effectively helps in the process of prescribing loads and recovery strategies. Data collection takes place in the same format mentioned above and then the value is multiplied by the duration of the session or match.[20,32] A systematic review in team sports found a high to very high correlation between session-RPE and

significant changes in neuromuscular and aerobic capacity as a function of prescribed training.[20]

In addition, the correct way to manage loads is to respect the concept of load dose-response, also known as acute-chronic workload ratio (ACWR). In this aspect, the acute load represents fatigue and is the accumulated load of the current microcycle. Chronic load refers to physical fitness and takes into account the average load values of the four previous microcycles.[2,12,26,33,38,40,44] In this equation, the numerator is the acute load and its respective denominator refers to the chronic load. A controversy among experts in the field consists of verifying whether the chronic load should be calculated in a coupled way (taking into account the values of the current microcycle) or in an uncoupled way (taking into account only the loads of the four previous microcycles). Regardless of this debate, ACWR is a valuable functional indicator that outlines numerical guidelines for players' state of preparation.[27,38]

ACWR values can fluctuate between different zones. When the calculation is in a range below 0.80, the athlete is subject to detraining and injuries, if this value persists in the medium and long term. Another zone is to fluctuate between 0.85 to 1.35. In this case, practitioners are in a safety zone where the risk of chronic injuries is low and, apparently, the load is well distributed. However, if the ACWR is between 1.5 and 2.0, the risk of non-contact injuries increases significantly.[2,25,33,38,41,45] Figure 01 illustrates a hypothetical example of the narrow range in conducting physical preparation work based on ACWR.

Figure 01. *Narrow range of physical fitness based on ACWR*



In a follow-up study for twenty-four consecutive weeks, with female basketball players, ACWR values ranged from 0.7 to 1.3.[24] In men's college basketball, in a ten-week analysis, ACWR was in a range of 1.0 to 1.5 in 60% of microcycles.[1] In a monitoring of forty-two microcycles, in professional European basketball, average ACWR values of 1.07, 1.10 and 1.06 were found at the beginning, middle and end of the competitive period.[12] Another investigation, with female players at university level, explained that ACWR fluctuated from a minimum value of 0.76 to a maximum of 1.18 during a period of twenty-eight microcycles.[46]

A valuable association between ACWR and injuries was made by Weiss *et al.* (26) in

professional basketball players. The distribution of injuries among athletes varied according to ACWR values, namely: ≥1.5 (59%), ≤0.5 (54%), 0.50-0.99 (51%), and 1.00-1.49 (36%). The authors consider the ACWR sweet spot to be the zone between 1.00 and 1.49.

Despite being well established and consolidated, the ACWR should not be the only operational tool to prevent injuries and monitor load control. The ideal scenario is to jointly analyze data on athletes' individual locomotor profile, training history, physical fitness tests, injury history, as well as employ psychometric questionnaires to have a broader view of what really happens during practice.[1,2,25,28,41] The context in which the team or player is inserted has a significant bearing on the metrics being used. Furthermore, such metrics must have good reliability, validity and usefulness.[1,34]

Individualization of loads in team sports is of great practical use, because the stimuli imposed on players during sessions tend to be uniform, almost homogeneous. On a few occasions, in training, players are separated into small groups respecting their tactical position.[9,42] The real benefit of individualized loads is to minimize the differences between responsive and less responsive players in the development of varied biomotor capabilities.[7,42,45]

It appears that well-dosed high chronic loads, built over time, serve as a protective mechanism to make the player more resilient to injuries and, at the same time, increase their level of preparation.[38,40] One thing to be careful about when distributing loads is to try to avoid so-called “spikes”, which symbolize sudden increases in the acute training load. Typically, these spikes tend to appear after low ACWR values.[24,25]

It is worth mentioning that both the improvement in athletic performance and the reduction of injury incidence through control and monitoring of loads belong to a multidimensional sphere. In other words, it is something extremely complex and imperfect, with great dependence on the interpretation carried out by the responsible practitioners.[34] Adding to this, it is known that each different biological tissue of the body has its own threshold of tolerance to loads.[6,25,27,47] With this in mind, blindly believing that an ACWR value above 1.5 implies a high susceptibility to injuries or their recurrence is disregarding the general profile of the athlete (robust or fragile, young or veteran).[1,25]

The opposite situation, applying insufficient training loads leaves athletes underprepared to face competitions, inducing a greater risk of injuries and deteriorating their performance.[38] Perhaps, a safer approach to solving this pertinent issue is to create nominal ACWR values specific to basketball, given that the zones proposed in the vast majority of investigations cover several sports.[1,2]

It is well established that training and game loads induce stimuli in the players' locomotor system.[27,44] Recent evidence has shown that in professional basketball, external game loads express a high stressful demand when compared to usual training loads. When tactical functions are taken into account, it seems that external players (positions 1, 2 and 3) are more required in some external mechanical load metrics compared to internal athletes (positions 4 and 5).[4]

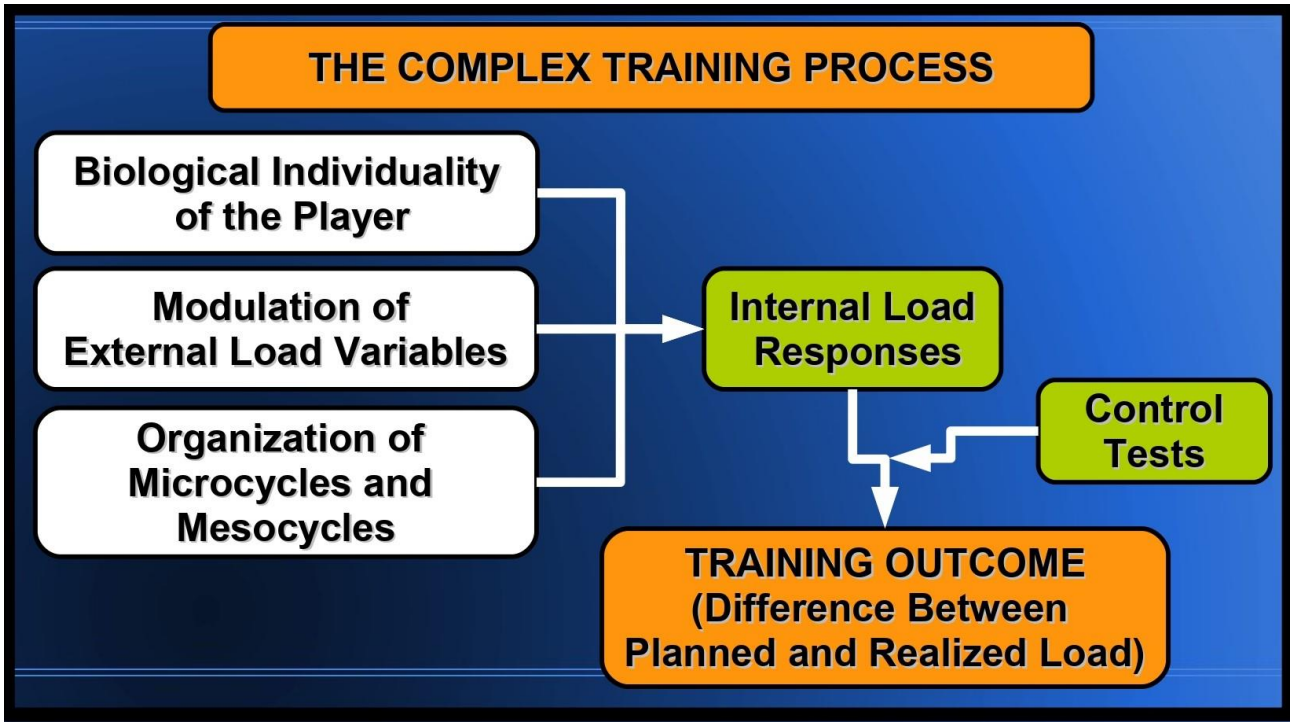
An interesting piece of information is when comparing the team's starting and reserve players. It is commonly accepted that starting players have higher game minutes compared to reserve athletes. In this sense, there is a real need to establish a minimum number of games for reserve players so that they can maintain good levels of physical fitness, similar to those of the starters. Compensatory training, in a microdosing format, with complementary loads for reserve players would help reduce this gap. This type of approach also reduces the incidence of injuries in reserve athletes.[3,25,48]

Monotony index and strain are two complementary metric indicators for understanding the behavioral load. The monotony index points to variability in the weekly load or a certain period. When high monotony values are found, it means that the training stimuli are fluctuating

little.[24,25,33] Strain, in turn, reflects the general stress induced by systematized training in relation to load and its variations. Very high strain and monotony can trigger the emergence of injuries and illnesses.[23,25] Monotony is calculated by dividing the average weekly load by the standard deviation of the microcycle load. Now, the strain formula consists of multiplying the weekly load by the monotony index.[24,33]

Lastly, it can be seen that all load metrics (external, internal, acute, chronic, monotony and strain) are closely interrelated. Therefore, the numbers produced by ACWR are a theoretically safe resource for quantifying load progression and regression strategies throughout a training program. The training load is of crucial importance for developing some aspect of physical fitness, preventing injuries and serving as a parameter in the rehabilitation process.[2,24,25,45]

Figure 02. *The complex training process [Adapted from Impellizzeri et al. (42)]*



4. PERIODIZATION IN COMPETITIVE BASKETBALL

Periodizing refers to the act of systematized planning of acute and chronic compulsory loads to optimize performance. Planning a training program for athletes eliminates the old intuitive ideology of prescribing loads. A well-structured program must be based on scientific ideas.[21,35]

The biological principles of sports training represent the laws in prescribing loads in periodization.[2,17] When this set of regulatory principles are transgressed, the training process becomes anarchic and athletic preparation does not progress.[19]

Organizational periodization procedures help to combine the most suitable systems, means and methods in the training program.[15] The periodization structure implies concentrated loads at certain times with alternation of reduced loads. Fluctuation between maximum, intense, moderate and light loads occurs during sessions or microcycles.[49,50] In the distribution of training loads, the

correct periodization model directs organic adaptive responses to solve specific problems.[21,50] There are numerous periodization models, but they can be classified into two categories: classic (traditional, theoretically rigid and inflexible, originating from the Soviet school) and contemporary (modern, alternative, highly flexible for formatting in different calendars).[15,21,51]

The selected periodization model runs in parallel with the pre-established objective for each stage of the season. From this starting point, some factors act simultaneously: the current state of preparation of the players, accommodation of loads with the competitive category and heterochronic compatibility between the stimulated biomotor capabilities.[16,17,52,53]

In a periodization of the season, three main periods stand out: preparatory, competitive and transition.[15,17,19,21,51]

The preparatory period or popularly called pre-season is where the sustainable foundations of the sporting form are built.[17] In addition to this, in this specific period, emphasis is placed on the significant increase in physical conditioning levels.[15,16,19] The volume of loads in the pre-season are greater than in the competitive period.[10,36,40,51] The value corresponds to two to four times higher (~1.3) compared to the competitive period. Even so, the risk of injury is considered low for those athletes who participate in a greater number of planned training sessions during this specific period. In team sports, it was shown that athletes who completed less than 50% of the sessions in the pre-season were not able to tolerate the loads of games in the competitive period.[40]

During the competitive period, official competitions predominate. At this stage, the goal is to maintain or increase the physical fitness gains acquired in the pre-season and technical-tactical ambiance to the tournament setup.[17] Multiple punctual peaks in the microcycles are part of this period of congested games.[15,36] In this context, some complicating factors arise, such as the number of competitions, number of days between games, quantity and distance of trips, quality of opponents, location of games, recovery from fatigue and injuries.[21]

The last period of the season is the transition. Players reduce workloads to recover from the long season.[21] But, at the same time, athletes try to perform an active recovery to maintain the biological rhythm and establish minimally acceptable standards of physical fitness.[15,51] It can be argued that this period is a true window of opportunity for athletes to correct their physical weaknesses and prepare for the next pre-season.[21]

Three temporal cyclic structures are part of periodization. The first functional structure is the microcycle. Its duration is short and usually varies between 3 and 10 consecutive days. However, the most commonly accepted is to use seven days, to coincide with a week in the Gregorian calendar.[15,21,53] Specific denominations are established for the microcycles to discriminate them according to the imposed load.[53] When searching the publications, it is clear that authors tend to vary the number of names of microcycles.[52,53] So, for the purposes of this study, four versions of microcycles were chosen: shock, ordinary, stabilizing and recuperative.[51]

The second structure, the mesocycle, lasts an average of three to six weeks. Normally, it is a consensus to use four weeks (one month).[51,53] This duration of the mesocycle corresponds to the minimum period necessary to acquire stable adaptations to continuous training loads.[16]

Macrocycle is the third and largest cyclical structure of periodization. The four-monthly, semi-annual or annual plan is called a macrocycle. The periodization diagram is subordinated by the macrocycle that would organize the logical distribution of mesocycles and microcycles.[15,16,51,53] The macrocycle is also accepted as structured in a multi-year manner.[19,51] In young athletes, the macrocycle has a significant weight, as the sporting form (integration of technical, tactical, physical and psychological aspects) is acquired over the long term of preparation.[17,51]

The smallest structural unit of periodization are training sessions.[16,17,51] Training sessions seek to resolve pedagogical questions necessary for the harmonious preparation of players. The fundamental division of the session includes an introductory part (warm-up), main part (nuclear

activities) and final part (organic recovery of loads).[51,53] Sessions are classified according to their structure (group, individual, mixed, unsupervised) or tasks (learning, reinforcement, improvement and evaluation).[35] The influence of the session on the player's body is the load.[55]

Load distribution in team sports is subject to the periodization of microcycles and mesocycles. In this same narrative, certain challenges are placed on the agenda for the professionals who make up the teams' staff. Among them are: the joint stimulation of multiple objectives, little time available for training and an extensive calendar with a high density of games.[16]

Stimulating multiple objectives in synchronization is hard work, extremely worthwhile as it is time-efficient. To achieve this purpose, without incurring biological incompatibility of activities, it will be necessary to respect a rational and logical ordering of the tasks adopted in the sequence of sessions (horizontal planning) and microcycles (vertical planning).[15,53]

The little time available to train is the result of the large number of regular competitions concentrated in weekly microcycles. In high-qualification leagues, there is substantially high psychobiological stress, with one to five games played weekly.[16,48] However, there are extreme situations, where formative basketball teams (U-18 and U-20) participate in seven matches within a short period of ten days.[43]

The season calendar varies depending on the league. North American university basketball teams have a short season, lasting around four to five months.[24] In European professional leagues, this period is eight months, with two or three games per week.[13] In professional Spanish basketball, the season described in the literature is forty-two weeks.[39] In the Brazilian league, U-19 category, the season lasts forty-nine microcycles and teams play two days a week.[18]

Table 01. *Planning the periodization of the season*

Period	Pre-Season	Competitive	Transition
Mesocycles	Aug. – Sept.	Oct. - May	June – July
Microcycles	1 to 8	9 to 41	42 to 50
Technical-Tactical Training	27	160	0
Physical Training	29	120	27
Recovery Training	25	46	9
Control Test Sessions	5	10	0
Game Load	3	66	0
Total	89	402	36

*[**LEGEND:** Aug.=August, Sept.=September, Oct.=October]*

Technical-tactical training encompasses the specific motor gestures for success in the sporting modality (technique) and the rational artifices designed to face opponents in the competitive scenario (individual and collective tactics).[8] Technical-tactical training can be fragmented into block, serial, constant, massed, distributed and\or randomized practices.[21,56] The selection of the type of practice is restricted to its main purpose: acquisition, retention or transfer.[56,57] Your intention is to strengthen the motor program of a certain technical ability or tactical system of the team. Exploring the solution of technical-tactical problems with contextual interference activates procedural memory and refines the motor response.[15,56] In tournaments, there is the presence of contextual interference in diverse formats, such as opponents' skills, social environment, team playing style, competitive environment, among other critical elements.[43] In this logic, deliberate practice with skills being repeatedly assimilated and constant feedback improves

decision making.[21] Cooperation between team athletes increases technical-tactical flexibility, favoring the creation of more unpredictable actions with the willingness to surprise opposing teams.[8]

In physical training, it is developed with the athlete's ability to tolerate metabolic, neuromechanical and physiological efforts. Both general and specific physical programs complement each other to increase the athletes' motor potential. Apparently, physical condition has a positive impact on technical-tactical requirements and organic-biological adaptive reconstructions.[8,53] In relation to physical training schemes, they include sessions to improve movement, metabolism, biomechanics and strength. Movement sessions involve working on learning movement, proprioception techniques, stability, mobility, flexibility and motor control. In sessions that focus on the metabolic part, anaerobic (alactic and lactic) and aerobic endurance is stimulated. Sessions with biomechanical proposals aim to improve kinesiological parameters of acceleration, deceleration, changes of direction, backpedal running, curvilinear running, lateral shuffle, crossover step, agility and speed. In strength sessions, five phases are present: anatomical adaptation, hypertrophy, maximum strength, power and power endurance.[58,59]

Recovery or programmed recuperative training is another piece of the puzzle in the intricate athletic preparation. Recovery training implements already known conventional recovery strategies (cryotherapy, compressive clothing, tapering session, massage, self-myofascial release, nutritional support, psychological therapies for managing emotional stability, sleep, manual therapy, etc.) for holistic regeneration of the body and mind.[5,19,21,60]

Control testing sessions are mandatory to check the current state of physical condition, discriminate tactical functions, evolution in physical fitness, evaluate body composition, analyze the quality of movement, prevent injuries, organize loads, correlate with game indicators, correct the direction of the training program, among other important aspects.[2,51,61] These tests must have reliability validated by scientific research and are divided into specific and non-specific.[51]

The game load is related to the number of matches that will be played in the microcycle. The greater the exposure to games, the greater the game load produced will likely be. The number of games is based on the number of competitions the team participates in the season.[39]

Table 02. *Types of sessions in microcycles and their content*

Types of Sessions	Contents
Technical-Tactical Training	Acquiring new skills, improving new variations of skills, learning the attack system, organization of the defensive system, game model, tactical versatility, simulating specific match scenarios, game rhythm, reduced games, etc.
Physical Training	Movement, metabolic, biomechanical and/or strength training
Recovery Training	Cryotherapy, compressive clothing, tapering session, massage, self-myofascial release, nutritional support, psychological therapies, sleep hygiene, manual therapy, etc.
Control Test Session	Field and laboratory tests
Game Load	Number of matches that will be performed in the microcycle

5. DISTRIBUTION OF LOADS ON MICROCYCLES

Properly distributing the total stressor loads in the microcycles is imperative for the general organization of the periodization.[54] As microcycles have a short duration, their sum can organize larger cycles as mesocycles.[53] Microcycles adjust to the needs of each specific period of the season.[2] It is well documented that the design of microcycles is a peculiar task and is related to each coach's particular philosophy, league calendar and player characteristics.[62]

During the imposition of training loads, athletes tend to show intra- and inter-individual variations to the pre-planned stimulus. While some players respond positively to loads, others may respond suboptimally due to low responsiveness. Likewise, there are also athletes who, with the same implemented load, present overtraining responses. The indicators that cause these discrepancies are: chronological age, biological age, gender, training history, genetics, injury history, adaptive capacity in relation to load, recovery capacity and mental state.[7,16,61,63]

Success in distributing loads is only established through sensitive manipulation of the content, order and quantity of sessions on the days that make up the microcycle. From this point of view, sessions with dissimilar objectives tend to have varying durations.[9] Training sessions can have a fixed or variable duration. The total time fluctuates depending on the objective, type of approach and period of the season.[4,9,64]

Professional basketball players train approximately five to twelve sessions in the microcycle with a varied number of games (no game, one game, and\or two games).[10,11,36,39,63] Formative players tend to train with a smaller number of sessions in microcycles depending on the category they are inserted in.[9]

There are two training periods per day: morning session and afternoon session.[36,59] During the sessions that constitute the microcycles, technical-tactical training, physical training, recovery training, control test sessions and game load will be somatized simultaneously.[17,36,51,53]

In microcycles, the density of games varies from one game per week to a greater number according to the calendar of the league in which the team is inserted. Microcycles with more than one game per week are called congested.[1,48]

It was verified in a follow-up of three consecutive seasons in college basketball that the training load one day before the game is more important than the training load two days ago. In this same study, the author reports that a large number of long sessions in the microcycle have a negative impact on match performance. A valid recommendation is that if the team has high levels of physical conditioning, the session before the game should focus its primary attention on tactical aspects so as not to have an adverse influence on the athletes' locomotor system.[22]

The popular and conservative rule of 10% increase in loads between microcycles does not always apply in the practical environment. It all depends on the players' condition. If the athlete is in the final phase of rehabilitation from the injury and has a low chronic load, this rule would greatly limit the time for returning to competitive activity. However, if the athlete has high chronic load values, he or she would not support loads above this rule in the progression between microcycles. A critical suggestion is to work with an adaptation of the rule, expanding its possibilities to around <10% up to 25% increase in weekly load, in accordance with the player's state of physical fitness.[25,41]

An athlete's game minutes represent their game load.[39,24] Individualizing these numbers allows players with greater game load to create an adjustment in the training load in the microcycle so as not to overload their locomotor system. However, for those athletes with less playing time, it will be necessary to supplement loads so that the difference in physical fitness is not too pronounced.[24] Associating the number of games in microcycles with the athlete's match

minutes allows us to better identify the dosage of loads during the season.[1]

There is still no consensus among scientific findings regarding the loads on microcycles with one- or two-game schemes. A study with college players revealed that with a weekly game the load on the microcycle tends to be high. When this data was classified according to starting and reserve athletes, starting players always had higher loads compared to reserves, regardless of the density of games.[1] However, in another investigation, there were no differences in the load used in microcycles with one or two weekly games.[63] Complementing this information, when analyzing professional players during a season, Clemente *et al.* (11) showed that in congested weeks, fatigue was higher when compared to regular weeks.

In our proposal, microcycles have special denominations with direct reference to the imposed load: ordinary, shock, stabilizing and recuperative.[2,51,59] In the same way that the microcycles are titled, the sessions that are managed in the microcycles receive similar names and dosage of loads: ordinary, shock, stabilizing and recuperative.[51]

Ordinary microcycles are those most commonly used. Their main characteristic is to ensure basic organic preparation to tolerate subsequent loads of greater magnitude. Their loads range from 60% to 80% of the stipulated maximum load.[2,51,53,59]

Tables 03 and 04 show hypothetical examples of an ordinary microcycle with one game per week. The microcycle has two daily sessions: in the morning (S-01) lasting 50 minutes and in the afternoon (S-02) lasting 90 minutes. Using RPE as values between 0 and 10, the maximum internal load value that can be achieved in the shock session in the morning is 2500 au and in the afternoon session it is equivalent to 4500 au. The game load counts as a session lasting 70 minutes (warm-up + game + cool down).[33] Thus, in the ordinary microcycle, the load from 60% to 80% fluctuates between a minimum value of 4620 au and a maximum of 6160 au.

Table 03. *Example of an ordinary microcycle with a weekly game*

	Mon.	**Tues.**	**Wed.**	**Thurs.**	**Fri.**	**Sat.**	**Sun.**
	MD+1	**MD+2**	**MD-4**	**MD-3**	**MD-2**	**MD-1**	**MD**
Load S-01 (au)	Day Off 0	350	200	450	200	450	Rest 0
Load S-02 (au)	Day Off 0	450	630	540	630	360	GAME LOAD 630
Daily Total (au)	0	800	830	990	830	810	630

[LEGEND: S-01=session one in the morning, S-02=session two in the afternoon, day off=passive rest, au=arbitrary units, MD+1=match day one more day, MD+2=match day two more days, MD-4=match day minus four days, MD-3=match day minus three days, MD-2=match day minus two days, MD-1=match day minus one day, MD=match day]

Table 04. *Example of descriptive metrics of the ordinary microcycle with a game*

Total number of sessions + matches (n)	11
Total duration (minutes)	770
Total week load (arbitrary units)	4890
Monotony Index	2,14
Strain Index	10464

In tables 05 and 06 an ordinary microcycle with two weekly games is portrayed. The viable strategy for distributing loads in the case of two games in the microcycle should be to select one of the games as priority and the other as secondary. In the priority game, the tapering that is carried out the day before aims to peak performance on the day of the match. In contrast, in the secondary game, the previous day keeps the loads high so that the minimum acceptable total volume of the microcycle can be reached.[63]

In this particular situation, the maximum load (shock) that can be achieved in sessions in the morning is 2500 au and in the afternoon 3600 au. In addition, the maximum game load that can be achieved is 1400 au. So, in the ordinary microcycle with two weekly games, the load value needs to oscillate between a minimum of 4500 au (60%) and a maximum of 6000 au (80%).

Table 05. *Example of an ordinary microcycle with two weekly games*

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
	MD+1	MD-2	MD-1	MD	MD+1	MD-1	MD
Load S-01 (au)	Day Off 0	250	350	200	200	400	Rest
Load S-02 (au)	Day Off 0	630	360	GAME LOAD 490	720	450	GAME LOAD 560
Daily Total (au)	0	880	710	690	920	850	560

*[**LEGEND:** S-01=session one in the morning, S-02=session two in the afternoon, day off=passive rest, au=arbitrary units, MD+1=match day one more day, MD-2=match day minus two days, MD-1=match day minus one day, MD=match day]*

Table 06. *Example of descriptive metrics of the ordinary microcycle with two games*

Total number of sessions + matches (n)	11
Total duration (minutes)	750
Total week load (arbitrary units)	4610
Monotony Index	2,08
Strain Index	9588

An intense mobilization for maximum organic reserves occurs in shock microcycles with substantially increased volume. Loads in this microcycle version fluctuate between 80% and 100% of the maximum load. Due to this pattern of high loads in a short period, the shock microcycle must be well planned during the week so as not to overload the locomotor system or negatively interfere in a nearby competition.[2,51,53]

The hypothetical examples in tables 07 and 08 reveal a shock microcycle with a weekly game. In this sense, the maximum expected load for sessions in the morning is 2500 au and in the afternoon it is 4500 au. Maximal game load would be around 700 au. Therefore, in the shock microcycle with a weekly game, the minimum acceptable total load is 6160 au (80%) and the maximum is 7700 au (100%).

Table 07. *Example of a shock microcycle with a weekly game*

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
	MD+1	**MD+2**	**MD-4**	**MD-3**	**MD-2**	**MD-1**	**MD**
Load S-01 (au)	Day Off 0	450	450	400	400	450	Rest
Load S-02 (au)	Day Off 0	810	630	810	630	540	GAME LOAD 630
Daily Total (au)	0	1260	1080	1210	1030	990	630

[***LEGEND:*** *S-01=session one in the morning, S-02=session two in the afternoon, day off=passive rest, au=arbitrary units, MD+1=match day one more day, MD+2=match day two more days, MD-4=match day minus four days, MD-3=match day minus three days, MD-2=match day minus two days, MD-1=match day minus one day, MD=match day* ***]***

Table 08. *Example of descriptive metrics of the shock microcycle with a game*

Total number of sessions + matches (n)	11
Total duration (minutes)	770
Total week load (arbitrary units)	6200
Monotony Index	2,01
Strain Index	12462

The shock microcycle with two weekly games is demonstrated in tables 09 and 10. When there are two weekly games in the shock microcycle, the days on which shock loads will be imposed must be correctly calculated so as not to have negative effects on the games. The dynamic is to prioritize one of the two matches. In the priority match, tapering is sought. In the other game, regular loads are implemented. In the shock microcycle with two games, the total load varies between a minimum of 6000 au (80%) and a maximum of 7500 au (100%).

Table 09. *Example of shock microcycle with two weekly games*

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
	MD+1	**MD-1**	**MD**	**MD+1**	**MD-2**	**MD-1**	**MD**
Load S-01 (au)	Day Off 0	400	250	300	350	400	Rest
Load S-02 (au)	Day Off 0	720	GAME LOAD 630	810	810	630	GAME LOAD 700
Daily Total (au)	0	1120	880	1110	1160	1030	700

[**LEGEND:** S-01=session one in the morning, S-02=session two in the afternoon, day off=passive rest, au=arbitrary units, MD+1=match day one more day, MD-2=match day minus two days, MD-1=match day minus one day, MD=match day **]**

Table 10. *Example of descriptive metrics of the shock microcycle with two games*

Total number of sessions + matches (n)	11
Total duration (minutes)	750
Total week load (arbitrary units)	6000
Monotony Index	2,08
Strain Index	12480

The central objective of stabilizing microcycles is to maintain the levels of functional physical fitness acquired by players. The loads established in this type of microcycle are equivalent to 40% to 60% of the maximum load.[2,51,59] The hypothetical example of a stabilizing microcycle with a weekly game can be seen in tables 11 and 12. Then, the load of this type of microcycle with a game per week fluctuates from the minimum tolerable value of 3080 au (40%) to the maximum value of 4620 au (60%).

Table 11. *Example of a stabilization microcycle with a weekly game*

	Mon.	**Tues.**	**Wed.**	**Thurs.**	**Fri.**	**Sat.**	**Sun.**
	MD+1	**MD+2**	**MD-4**	**MD-3**	**MD-2**	**MD-1**	**MD**
Load S-01 (au)	Day Off 0	300	200	350	150	350	Rest
Load S-02 (au)	Day Off 0	540	450	180	630	270	GAME LOAD 490
Daily Total (au)	0	840	650	530	780	620	490

[***LEGEND:*** *S-01=session one in the morning, S-02=session two in the afternoon, day off=passive rest, au=arbitrary units, MD+1=match day one more day, MD+2=match day two more days, MD-4=match day minus four days, MD-3=match day minus three days, MD-2=match day minus two days, MD-1=match day minus one day, MD=match day* ***]***

Table 12. *Example of descriptive metrics of the stabilization microcycle with a game*

Total number of sessions + matches (n)	11
Total duration (minutes)	770
Total week load (arbitrary units)	3910
Monotony Index	2,02
Strain Index	7898

Two weekly games in the stabilizing microcycle are shown in tables 13 and 14. Even though it is a stabilizing microcycle, it is necessary to prioritize one of the matches for peak with tapering and the second match for regular loads. In the stabilizing microcycle with two games, the minimum total load is 3000 au (40%) to 4500 au (60%).

Table 13. *Example of stabilization microcycle with two games*

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
	MD+1	MD-1	MD	MD+1	MD-2	MD-1	MD
Load S-01 (au)	Day Off	250	Rest	150	250	400	Rest
Load S-02 (au)	Day Off	180	GAME LOAD 630	360	360	180	GAME LOAD 420
Daily Total (au)	0	430	630	510	610	580	420

*[**LEGEND:** S-01=session one in the morning, S-02=session two in the afternoon, day off=passive rest, au=arbitrary units, MD+1=match day one more day, MD-2=match day minus two days, MD-1=match day minus one day, MD=match day **]***

Table 14. *Example of descriptive metrics of the stabilization microcycle with two games*

Total number of sessions + matches (n)	10
Total duration (minutes)	750
Total week load (arbitrary units)	3180
Monotony Index	2.09
Strain Index	6646

The loads of the recuperative microcycle are structured in such a way as to provide a restoration of psychobiological stress. Nominal load values are low, fluctuating between 10% and 40% of the maximum expected load.[2,51,59]

A weekly game in the recuperative microcycle can be seen in tables 15 and 16. In this example, with a weekly game, the recuperative microcycle oscillates from the minimum total value of 770 au (10%) to the maximum of 3080 au (40%).

Table 15. *Example of a recuperative microcycle with a weekly game*

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
	MD+1	MD+2	MD-4	MD-3	MD-2	MD-1	MD
Load S-01 (au)	Day Off 0	150	250	350	250	250	Rest
Load S-02 (au)	Day Off 0	180	180	270	360	180	GAME LOAD 560
Daily Total (au)	0	330	430	620	610	430	560

*[**LEGEND:** S-01=session one in the morning, S-02=session two in the afternoon, day off=passive rest, au=arbitrary units, MD+1=match day one more day, MD+2=match day two more days, MD-4=match day minus four days, MD-3=match day minus three days, MD-2=match day minus two days, MD-1=match day minus one day, MD=match day **]***

Table 16. Example of descriptive metrics of the recuperative microcycle with a game

Total number of sessions + matches (n)	11
Total duration (minutes)	770
Total week load (arbitrary units)	2980
Monotony Index	1,97
Strain Index	5870

Tables 17 and 18 show a recuperative microcycle with two weekly games. In this example, in particular, as the loads are low, tapering can be discarded so that the sum of the session loads reaches a total volume within the limits of the recuperative microcycle. In the recuperative microcycle with two weekly games, the minimum total workload is 750 au (10%) to a maximum of 3000 au (40%).

Table 17. *Example of a recuperative microcycle with two weekly games*

	Mon.	**Tues.**	**Wed.**	**Thurs.**	**Fri.**	**Sat.**	**Sun.**
	MD+1	**MD+2**	**MD-4**	**MD-3**	**MD-2**	**MD-1**	**MD**
Load S-01 (au)	Day Off 0	100	Rest	50	100	100	Rest
Load S-02 (au)	Day Off 0	90	GAME LOAD 630	180	270	180	GAME LOAD 700
Daily Total (au)	0	190	630	230	370	280	700

[LEGEND: *S-01=session one in the morning, S-02=session two in the afternoon, day off=passive rest, au=arbitrary units, MD+1=match day one more day, MD+2=match day two more days, MD-4=match day minus four days, MD-3=match day minus three days, MD-2=match day minus two days, MD-1=match day minus one day, MD=match day* ***]***

Table 18. *Example of descriptive metrics of the recuperative microcycle with two games*

Total number of sessions + matches (n)	10
Total duration (minutes)	700
Total week load (arbitrary units)	2400
Monotony Index	1,38
Strain Index	3312

6. DISTRIBUTION OF LOADS IN THE MESOCYCLES

In the mesocycle, the coach is able to systematize over time the successive microcycles that constitute it.[51,53] Basically, there are six ways for players to transition and reach their ideal state of physical fitness in the mesocycles. This premise addresses three important concepts: floor, ceiling and available time. The floor would configure the preparatory period, where physical fitness is

gradually built. The ceiling is the final physical fitness goal to be aimed at, which can occur at the end of the pre-season or during some mesocycle of the competitive period. The available time deals with the space of time available to reach the pre-established ceiling.[65]

The first route is to have plenty of time available for physical conditioning to progress from the floor to reaching the ceiling. This would be possible when all athletes carried out appropriate training during the off-season and performed in the pre-season in minimally acceptable physical conditions. The second possibility is that there is no time available to gradually progress from floor to ceiling. Various causes can generate this type of situation. One of them would be for the player to be injured during the pre-season or for it to last for a very short period of time. In the third line of reasoning, the athlete manages to achieve his physical fitness goal before the time available. This fact may occur due to having carried out more extensive training in the transition period and, therefore, minimizing the preparation time it would take to reach the ceiling during the pre-season. In the fourth possibility, the athlete started from the floor and completed the time, but did not reach the pre-defined ceiling. Such an observation may occur if there is a lack of organization when building fitness in the pre-season. The fifth dynamic portrays an athlete who presents himself in the pre-season with a floor much lower than expected and ends up completing the available time without achieving the proposed objective (ceiling). This scenario is common when there is a lack of stimuli during the transition period. Finally, in the sixth circumstance, the player starts the pre-season with a floor much higher than expected. In this aspect, with time available for load progression, it ends up reaching a ceiling above that predicted.[65] That said, the ceiling may even seem like an unreachable moving target that is continually improving. However, only when players reach the ceiling would they be able to withstand the more difficult demands of matches.[25]

One format for organizing the mesocycles is to orient them in groupings of four microcycles with their respective loads and thus be able to calculate the coupled ACWR of that mesocycle (table 19).

Table 19. *Distribution of loads in four consecutive mesocycles*

Meso 05	Load	Meso 06	Load	Meso 07	Load	Meso 08	Load
Micro 20	4500	Micro 24	5380	Micro 28	4590	Micro 32	6170
Micro 21	4709	Micro 25	6009	Micro 29	3000	Micro 33	2900
Micro 22	6100	Micro 26	2800	Micro 30	3276	Micro 34	4690
Micro 23	5389	Micro 27	4486	Micro 31	2996	Micro 35	4490
ACWR	1.04		0.96		0.86		0.98

[**LEGEND:** meso=mesocycle, micro=microcycle, ACWR=acute-chronic workload ratio **]**

A prevailing concern is how to properly sequence the different types of microcycles within the framework of a given mesocycle. In this topic there is no simple guiding rule. The answer will depend on numerous variables that affect the team's individual and collective work capacity.[59] A concrete possibility for a rational combination would be to work two ordinary microcycles followed by a shock microcycle and, concluding, with the ordinary microcycle. This approach works efficiently in the early pre-season mesocycle (table 20). It also resembles the traditional 3:1 load modulation described in most publications.[16]

Table 20. *Example of sequential distribution of microcycles in mesocycle 05*

Mesocycle 05	Micro 20	Micro 21	Micro 22	Micro 23
Type	Ordinary	Ordinary	Shock	Ordinary
Training Load (au)	4500	4709	6100	5389

[**LEGEND:** micro=microcycle, au=arbitrary units]

Another possibility of mesocycle structure is to construct it starting with an ordinary microcycle, followed by a shock, recuperative microcycle and, ending, with a stabilizing microcycle. This sequential configuration would adapt to some intermediate pre-season mesocycle or even during the competitive period (table 21).

Table 21. *Example of sequential distribution of microcycles in mesocycle 06*

Mesocycle 06	Micro 24	Micro 25	Micro 26	Micro 27
Type	Ordinary	Shock	Recuperative	Stabilization
Training Load (au)	5380	6009	2800	4486

[**LEGEND:** micro=microcycle, au=arbitrary units]

A third operational condition is to start the mesocycle with an ordinary microcycle to raise the parameters of the sports form. In sequence, two stabilizing microcycles with the purpose of maintaining work capacity and, concluding with a recuperative microcycle. This mesocycle would be indicated when there is great fatigue in the team during the competitive period, but at the same time, a drop in athletic performance is avoided. For example, in the short stages of the play-offs (table 22).

Table 22. *Example of sequential distribution of microcycles in mesocycle 07*

Mesocycle 07	Micro 28	Micro 29	Micro 30	Micro 31
Type	Ordinary	Stabilization	Stabilization	Recuperative
Training Load (au)	4590	3000	3276	2996

*[**LEGEND:** micro=microcycle, au=arbitrary units]*

The fourth example consists of a mesocycle that begins with a shock microcycle, followed by a recuperative, ordinary and stabilizing one. This situation is useful during a mesocycle in the middle of the competitive period, when the team is not experiencing high fatigue, but also needs attention in managing sports form (table 23).

Table 23. *Example of sequential distribution of microcycles in mesocycle 08*

Mesocycle 08	Micro 32	Micro 33	Micro 34	Micro 35
Type	Shock	Recuperative	Ordinary	Stabilization
Training Load (au)	6170	2900	4690	4490

[**LEGEND:** micro=microcycle, au=arbitrary units]

Maintaining players in high readiness to train and compete depends on how the loads are distributed. Pre-planning is a crucial task for the training process to be well conducted. However, we must remember that discrepancies may occur between what was estimated in planning and what was actually carried out in practice.[2,15,59]

Numerically, each period of the season has its particularities in the distribution of loads in microcycles and mesocycles. Furthermore, there are certain safety thresholds to be observed when prescribing training. Players exposed to loads much higher or lower than the proposed reference threshold may predispose them to the appearance of injuries.[45,66]

Therefore, the examples of microcycles and mesocycles that were reported throughout this study are hypothetical values, presented only to illustrate the metrics that can be produced in the load distribution. The most correct way to address load management is through long-term monitoring of the players' dose-response relationship to the implemented load and, from this, create minimum and maximum average reference thresholds.

An important point that should not be neglected is that the training load must be adapted according to the players' age. More experienced athletes are more susceptible to injuries when compared to younger players under the same workload. This observation corroborates the need for fine adjustments to the load individually and collectively within the same team.[45]

7. CONCLUSION

Competitive basketball as a contemporary team sport is hostage to the immediate results demanded by the media. In this way, players with high readiness to train and participate in games is part of the long-term training process.

For this reason, in particular, training load control can be considered a valuable operational tool. It is believed that meticulous distribution of loads in basketball microcycles and mesocycles is an arduous and highly complex task. In this perspective, periodization planning and its respective organization represent the macrostructure. On the other hand, the logical sequencing and content of activities encompass the microstructure.

Appropriate modulation of external load variables induces satisfactory internal load responses. Functional metrics such as the monotony index, strain index and ACWR help coaches to be able to translate what happens in the players' locomotor system and, therefore, recalibrate the imposed loads in a more reliable way.

Finally, raising the levels of sporting form while the team participates in multiple tournaments must be the guiding principle if we want to optimize athletic performance in conjunction with low injury risk.

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